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Joint Assessment of Renewable Energy and Water Desalination Research Center (REWDC) Program Capabilities and Facilities In Radioactive Waste Management

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Disclaimer

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Joint Assessment of
Renewable Energy and Water Desalination Research Center (REWDC)
Program Capabilities and Facilities
in
Radioactive Waste Management

Sister Laboratory
Action Sheet P-05-5 “Radioactive Waste Management”

Global Security Engagement and Cooperation
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SUMMARY

The primary goal of this visit was to perform a joint assessment of the Renewable Energy and Water Desalination Center's (REWDC) program in radioactive waste management.

The visit represented the fourth technical and scientific interaction with Libya under the DOE/NNSA Sister Laboratory Arrangement. Specific topics addressed during the visit focused on Action Sheet P-05-5, "Radioactive Waste Management." The Team, comprised of Mo Bissani (Team Lead), Robert Fischer, Scott Kidd, and Jim Merrigan, consulted with REWDC management and staff. The team collected information, discussed particulars of the technical collaboration and toured the Tajura facility. The tour included the waste treatment facility, waste storage/disposal facility, research reactor facility, hot cells and analytical labs. The assessment team conducted the first phase of Task A for Action Sheet 5, which involved a joint assessment of the Radioactive Waste Management Program. The assessment included review of the facilities dedicated to the management of radioactive waste at the Tourja site, the waste management practices, proposed projects for the facility and potential impacts on waste generation and management.

As a result of the assessment, preliminary recommendations of the U.S. technical team are:

1. Evaluate each step of the waste treatment process for appropriateness and effectiveness in treating current and future waste streams.
2. Consider replacing and/or upgrading key waste treatment units.
3. Strengthen the overall waste management system.
4. Evaluate the waste storage/disposal facility for compatibility with planned waste generation requirements. In addition, determine if current storage facility will become final disposition for waste or temporary storage until a more suitable burial site becomes available.
5. Identify waste streams and treatment methods for current and projected waste streams.
6. Evaluate the refueling of the reactor for potential waste streams.
7. Establish Quality Assurance Systems.
8. Develop *Quality and Safety Manual* and training.
9. Improve the development and delivery of training.
10. Establish Integrated Safety Management.

RADIOACTIVE WASTE MANAGEMENT AND ASSOCIATED FACILITIES

REWDC is equipped with a substantial waste management infrastructure. The waste management facilities were installed in conjunction with the research reactor and designed to specifically support reactor and research operations. The waste management facilities were part of the Soviet designed research center, which was built for the Libyans as a turnkey nuclear research center. The waste management system appears to be based on similar systems designed and built in the Soviet Union in the mid-1970s. A review of International Atomic Energy Agency (IAEA) literature from the mid-1980s includes a description of the waste treatment facilities installed at the Moscow Station for Handling Radioactive Waste. The system as described seems to follow the same basic treatment process as those employed (or envisioned to be employed) at REWDC. Appendix J contains a reproduction flow chart for the Moscow Station treatment system. Drawings and procedures for most of the major pieces of equipment were available. The original contract with the Soviet Union to build the Tajura site included a requirement that all technical documentation and drawings be provided in English, which makes review of documentation required much easier.

The major components of the REDWC waste management system are divided between two primary sites. Building 7 houses the liquid waste treatment facility and Building 35 houses the solid waste processing and storage and disposal facilities. The facilities are sufficiently staffed by a team comprised of one senior manager, four engineers, and 16 technicians.

The staff is well versed on the operation of certain system components such as the ion exchange system but is less comfortable with other components such as the evaporator and solidification units. As a result, only a portion of the originally designed system is being operated. As originally designed, the system appears to provide for the total lifecycle management, providing waste treatment options for all projected waste streams from generation to final disposal. Since major components of the system are not operating, the ability of REWDC to adequately manage future waste generation volumes and types needs to be assessed.

The centerpiece of the REWDC is a research reactor. The waste management system has been specifically designed to support the operation of the reactor. The reactor facility was built in 1980 with assistance from the Soviet Union and was started (first criticality) in 1981. The reactor, an IRT type using IRT-2M fuel (which is an 80 percent enriched box-type uranium dispersion fuel) was designed to operate at a rated power of 10 MW, but REWDC does not run above approximately 5-8 MW. Maximum thermal flux level in the core is approximately $2x10^{14}$. The reactor is currently being converted to run on a lower enriched fuel and is expected to resume operations in September of this year. The reactor has not operated routinely in more than a year, and previously had operated at only 1-5 MW. The runs consisted of eight to twenty hours per week of continuous operation. There are 11 horizontal beam tubes in the facility although none are currently used. Numerous irradiation positions are available in the beryllium reflector surrounding the core as well as in internal core positions.

Liquid Waste Treatment Facility

Building 7 houses the liquid waste treatment facility. The building consists of three stories with two above grade and one below. During the time of the assessment renovations were being made to the facility making it difficult to determine what impact they would have on the facility. The facility contains all of the components of a liquid waste treatment system, analytical laboratories and offices.

The liquid waste treatment system is a batch processing system designed to handle liquid effluent from a variety of site operations. Liquid from across the site is transferred by underground piping to one of two large receiving tanks. Facility operators report that prior to transfer analytical results are obtained and each transfer is reviewed against treatment system parameters. When the receiving tank reaches an appropriate level, additional samples are obtained to determine certain basic parameters such as pH, total dissolved solids, conductivity and radioactivity levels. The liquid is then transferred to a chemical preparation tank where a basic hydroxide preparation is performed. This involves acidifying the waste with nitric acid, oxidizing the metals to their highest state with hydrogen peroxide, and adding ferric chloride to produce increased coagulation and sodium hydroxide as the final step in precipitating out the metals.

After chemical preparation, the liquid is passed through a gravity filtration system consisting of sequential layers of marble, sand, charcoal and dolomite. The filtered liquid then passes to the ion exchange system. The ion exchange system consists of separate anion and cation exchange columns. The liquid is run through each of the columns in series. Each ion exchange column contains approximately three cubic meters of ion exchange media. Facility personnel report the ion exchange columns have only just become spent and the first stage had to be changed out after the resin could no longer be regenerated. Columns are regenerated using either nitric acid or sodium hydroxide. The change out of the first stage of the ion exchange system resulted in the generation of 30 drums of spent ion exchange resin that are reportedly in temporary storage.

It was unclear what, if any, conditioning for long-term storage or disposal of the spent resin had taken place. After ion exchange the liquid is sent to a large collection tank where it is sampled and then either discharged or returned for further treatment.

The treatment facility includes a liquid evaporation system. The evaporator has never been used for waste treatment, and according to personnel was only tested once in 1989. REWDC waste management staff were interested in bringing the evaporator online. Liquid waste evaporation could provide an important augmentation to the REWDC waste treatment capability. Liquid waste evaporation is an extremely flexible technology requiring little or no pretreatment of incoming waste and very little byproduct and provides a much higher quality product (waste water).

The current liquid waste treatment process generates secondary waste in the form of precipitates from the chemical preparation process, back flush liquid from the gravity filters and ion exchange regeneration liquids. It was unclear how REDWC is managing these waste streams.

Solid Waste Treatment

The solid waste treatment facilities are located at Building 35. The building is a two-story, concrete structure equipped with the following solid waste treatment components:

- Solid waste compactor.
- Solidification hot cell.
- Associated ventilation systems.

Reportedly, neither the hot cell nor compactor has been operated. The compactor was undergoing testing just prior to the assessment. A solidification system is located in the adjacent waste storage and disposal facility. The solidification system was designed to receive liquid waste from the liquid waste treatment facility and mix it with cement creating a grout mixture for in situ disposal of liquids in underground disposal vaults. It was unclear whether or not the cement system had been operated. Waste management personnel expressed a reluctance to grout waste in place due to the difficulty it would create if waste retrieval ever became necessary. There is a need for a waste conditioning system to solidify spent ion exchange resins and evaporator concentrates.

Waste Storage and Disposal Facility

The waste storage and disposal facilities are co-located in a large metal skinned building. The facility consists of 14 concrete lined in-ground vaults. The vaults are six meters deep. To date only one vault has been partially filled with radioactive waste. Each vault has a removable concrete lid. Radioactive waste is reportedly placed directly into the vault. The original Russian design for the facility called for the waste to be grouted into place using a cement grouting system. Radioactively contaminated liquids from the waste treatment facility would be mixed with the cement and the resulting grout would be used to form a concrete layer in the vault. Waste management personnel stated that the waste would be grouted in layers in the vaults.

Apparently the grouting system has never been used as waste management personnel expressed concern that the waste would become irretrievable after grouting. The top of the concrete vaults is used for storage and several filters and drums were observed in the facility. It was unclear whether the vault system was to be considered a disposal facility or if it was better described as an interim storage facility.

The distinction between disposal and long-term storage is an important one. If the facility is to be considered only for storage, then all waste must be conditioned in such a manner as to allow for its eventual retrieval. If the facility on the other hand is to be considered a disposal system then the ability to retrieve the waste is not an issue. The performance of the facility over the long-term needs evaluation. It was unclear whether or not an IAEA compliant performance assessment has been conducted on the disposal system. Depth to ground water is reported to be 40-80 meters.

Current and Projected Waste Streams

The REWDC facility generates a variety of waste streams. During the assessment an effort was made to document and understand both current and future waste streams. From the identification of waste streams, the current REWDC waste management system should be evaluated and recommendations made for improvements in the system. Appendix D contains a listing of the waste streams generated at REWDC and tentative assignment of treatment options. This listing is only partially complete but should serve as a template upon which a comprehensive waste management strategy could be built.

WASTE MANAGEMENT QUALITY ASSURANCE

Quality assurance (QA) is an essential component of a good waste management program. A quality assurance training session was provided for REWDC's management team during this visit. The training content addressed the various aspects of a defensible quality assurance program, including:

- Basic QA structure and hierarchy.
- Individual QA elements/criteria.
- Underlying QA principles.
- Practical implementation examples.

Appendix C of this document provides a comprehensive listing of the presentation content.

The discussions following the presentation indicated there was a general understanding of QA among the REWDC management team, with a strong understanding displayed by the head of the REWDC Quality Assurance Unit. An evaluation of REWDC's quality assurance organizational structure, regulatory requirements, policies and procedures as they apply to the facility's waste management processes was conducted. However, a comprehensive evaluation of the facility's QA policies and procedures could not be completed due to the immaturity of the QA program's documentation. Though a full suite of QA documentation was properly identified, the majority of these documents were in some stage of development (i.e., draft documents, partially written documents or documents yet to be generated) due to a lack of skilled staff assigned to the generation of the needed documentation. The need for REWDC's management to evaluate their staffing in this area was communicated. Additionally, the importance of maintaining an adequately staffed QA unit within the REWDC organizational structure was stressed to ensure the effective implementation, oversight and maintenance of a robust and effective QA program.

In reviewing REWDC's external quality assurance drivers, two governing organizations were identified: IAEA and the International Standards Organization (ISO). The IAEA regulatory requirements appeared to be well understood. The ISO 9001 requirements could not be demonstrated as being well understood. The need for the REWDC to employ the skills of an ISO 9001 knowledgeable contractor was identified and discussed.

REWDC's oversight (e.g., assessment) processes are early in the development stage. Topical areas of assessment are identified but a formal structured assessment process could not be demonstrated.

RECOMMENDATIONS

This report represents the first phase of the joint assessment of the REWDC program and addresses the first task of Sister Laboratory Action Sheet P-05-5, "Radioactive Waste Management." The first task, which calls for a joint assessment and evaluation of the REWDC waste management program states:

> *DOE National Laboratory staff will visit REWDC for a joint assessment of the existing capabilities, equipment, and radioactive waste. This assessment will include identification of existing and future radioactively contaminated materials and equipment, as well as new equipment and systems that need to be acquired. At the end of the joint assessment, DOE Laboratory staff will generate a report that contains specific findings and recommendations relevant to this subject.*

Following the tour of the REWDC facilities and discussions with REWDC management and technologists, the U.S. and Libyan teams jointly determined the following recommendations:

Recommendation 1 – Evaluate each step of the waste treatment process for appropriateness and effectiveness in treating current and future waste streams generated.

Discussion: The assessment team reviewed the current waste management infrastructure and believes that the current waste treatment infrastructure must be thoroughly reviewed as to its adequacy for current and future operations. The current system may be larger and more complex than necessary to support future operations. The technology being used is sound but is designed to handle a much larger throughput than what has occurred during the past and what can be expected from future operations. The result is a large and difficult-to-maintain waste treatment system. At a minimum the control system should undergo the same review and upgrades as those proposed for the reactor building.

The current process generates several difficult-to-handle secondary waste streams that should be re-evaluated. The ion exchange system for example is regenerated using strong acids and bases. The subsequent regeneration waste must be neutralized and treated as radioactive waste. It may be more efficient to forgo ion column regeneration and simply condition the spent ion exchange resins in concrete. As mentioned earlier in this report it was unclear how REDWC was currently handling the ion exchange regeneration waste. The gravity filters and chemical conditioning steps each generate secondary waste streams that can be difficult to handle. The use of theses two steps should be reviewed and possibly limited to only reactor pool conditioning thus limiting the secondary waste streams from these processes. With additional pretreatment of reactor pool make-up water the chemical preparation and filtration steps may also be considered for elimination. Since REDWC does not appear to have an established waste conditioning process the generation of these secondary waste streams is particularly of concern.

Proposed Task: A joint team of REDWC and LLNL personnel evaluate each treatment step and determine the following:

- Is the treatment step necessary to support operations?
- What is the optimum size of the unit?
- What upgrades are required for optimal treatment performance?

Recommendation 2 – Consider replacing and/or upgrading certain key waste treatment units.

Discussion: The assessment team identified several components of the REDWC waste treatment system that should be evaluated for replacement. As a first step in the evaluation process the following four waste treatment units were identified for upgrade or replacement. The assessment team is recommending units, which operate in smaller batch modes than the units they would be replacing.

Evaporator – The current liquid waste treatment facility contains two waste evaporators. According to waste treatment personnel the evaporators have never been used to treat waste. Waste management personnel have expressed an interest in establishing a waste evaporation treatment process. An option to starting the existing evaporator would be to instead purchase a modern waste evaporation unit. Appendix E of this report contains an example of a unit that could be assessed for application to REDWC waste streams.

This particular unit operates in a batch mode and is capable of evaporating a wide variety of low activity aqueous waste. The suggested unit is comprised of two sub units: a typical boiling evaporator and an in-drum evaporator. The units are designed to work in tandem with the evaporator concentrating the liquid to a certain point. The drum evaporator then takes the concentrate and evaporates it further to reduce the by-product generated. The resulting condensed slurry can then be appropriately conditioned for long-term storage or disposal.

Compactor – The solid waste treatment facility has a waste compactor that was installed as part of the original facility. During the assessment, REDWC personnel indicated that the compactor had not been used for processing waste and was only recently being tested for use. While the assessment team did not have sufficient time to fully evaluate the existing compactor, team members felt that it may be more efficient to replace the current unit with a modern in-drum compactor. A typical unit is described in Appendix F. The advantage of in-drum compaction is that the waste is compacted in the drum it will be disposed of in. Such a unit would give REDWC personnel the option of dispose of compacted waste in drums that are easily retrievable.

Cementation Process – The REDWC waste disposal facility is equipped with a large cement solidification unit that is designed to provide in situ solidification of sludge from the waste treatment facility. The unit solidifies liquid waste directly in a series of below ground reinforced concrete vaults. It is the understanding of the assessment team that the cementation unit has never been used to process waste into the underground vaults. This unit is designed to handle large volumes of treatment residues. The current waste treatment facility produces only small volumes on an occasional basis. A conditioning process is definitely needed at REDWC to prepare waste for either long-term storage or disposal. The assessment team recommends that REDWC consider purchasing an in-container solidification system. A typical unit is described in Appendix G. Such a system would solidify waste treatment residues including ion exchange resins in standard 208-liter drums that could then be placed into the underground vault system.

Small Scale Immobilization System – The REDWC solid waste processing facility is equipped with a hot cell designed to provide for the solidification of high dose rate waste. Waste management personnel indicate that the hot cells have never been operated and there are no plans to operate the cells in the future. The assessment team recommends that REDWC consider purchasing a small-scale waste immobilization unit that could be placed into one of the current radioisotope production hot cells. A typical unit is described in Appendix H. Small volumes of high dose rate waste could then be solidified directly in the hot cells and transferred to the waste storage/disposal facility as a solidified waste for long-term storage and or disposal.

Proposed Tasks: REDWC and LLNL personnel should jointly review the above listed equipment recommendation and determine appropriate replacement units. The assessment shall also determine the feasibility of restarting existing equipment as an alternative to purchasing new equipment when appropriate. Additionally LLNL and REDWC could jointly work on the development of conditioning processes for spent resins and other waste streams requiring conditioning prior to disposal.

Recommendation 3 – Strengthen the overall waste management system. This recommendation includes training, standardized waste collection containers, marking and labeling laboratory sinks, and labeling drums.

Discussion: The assessment team observed the overall waste management system and recommends that REDWC take the following steps toward developing a comprehensive waste management system:

Establish a waste segregation policy – This policy would provide the framework for segregating radioactive waste from non-radioactive waste and short-lived isotopes from long-lived isotopes.

Develop a Decay in Storage (DIS) program – Since REDWC is planning to increase the production of medical isotopes over the next few years there will be an increase in the amount of waste contaminated with short lived isotopes. A DIS program will allow for these wastes to be held the appropriate length of time and then released.

Develop an integrated documentation program – The assessment team observed the absence of identifying labels on waste containers. Sinks draining to retention systems were not marked. In general piping and tanks were not labeled. The assessment team was unable to observe the waste documentation program but recommends that future assessments review the system to ensure that waste is adequately tracked throughout the lifecycle from generation through to disposal (cradle to grave).

Standardize waste containers – The assessment team observed a wide variety of waste containers being used for storage and disposal. Some of these containers were in poor condition and were not designed for long-term storage.

Training – Establish a training program for waste treatment facility personnel. Establish a training program for waste generators. Training of personnel will become increasingly important as more operations are brought on line and both the quantity and variety of waste increases.

Proposed Tasks: A joint LLNL/REWDC team develops a comprehensive waste management program. This would include the development of the necessary plans, procedures and specifications to ensure the implementation of a quality program. LLNL can provide access to Radioactive and Hazardous Waste Training modules (EP0006 COR-HZ/RD) developed at LLNL for use in training LLNL waste generators.

Recommendation 4 – Evaluate the waste storage/disposal facility for compatibility with planned waste generation requirements. In addition, determine if current storage facility will become final disposition for waste or temporary storage until a more suitable burial site becomes available.

Discussion: The current waste system was designed to dispose of waste in below ground vaults. The waste was planned to be grouted in place. During the assessment the team received feedback from the REDWC staff that indicated there is a reluctance to grout waste in place because of the difficulty in retrieving such waste. REDWC should evaluate the existing facility and determine if it will be classified as a long-term storage facility or a disposal facility. The designation is important because it determines the type of disposal/storage operations that will take place. If it is decided that the facility will be operated as a storage facility, then waste will need to be conditioned into containers that can be retrieved during the storage time period. Designation as a storage facility will also mean that the current waste conditioning system of in-ground grouting will need to be replaced with a different container based system.

Proposed Tasks: Evaluate the current disposal/storage facility for suitability for disposal. Develop waste acceptance parameters to ensure the integrity of the disposal system (if disposal is deemed acceptable). Make recommendation to REDWC as to whether facility should be operated as a long-term storage or disposal facility.

Recommendation 5 – Identify waste streams and treatment methods for current and projected waste streams.

Discussion: During the assessment, the team noticed several waste streams in temporary storage with no apparent disposal pathway. Examples of these waste streams included HEPA filters, smoke detectors and spent resins. The assessment team developed a preliminary waste matrix (Appendix D), which identified major waste streams. This identification process should continue in the future, along with the identification of appropriate treatment techniques.

The matrix will allow for personnel to develop appropriate conditioning methods for each waste stream.

Proposed Task: Continue to refine the waste stream matrix presented in Appendix D. Develop conditioning techniques for all identified waste streams.

Recommendation 6 – Evaluate the refueling of the reactor for potential waste streams.

Discussion: The reactor is scheduled to be refueled with a new type of fuel in the next few months. The refueling process should be evaluated to determine if any waste streams will be generated, which will need immediate attention. Possible waste streams could include activated metals from the reactor internal components, sludge or debris from the reactor pool. There may also be a need for increased treatment of reactor cooling water during the replacement operations. If appropriate, a waste management plan should be developed detailing the disposition of wastes generated during reactor refueling.

Proposed Task: Conduct a joint assessment of the refueling program to identify the generation of any potential waste streams. Develop a waste disposition plan for any waste streams identified.

Recommendation 7 – Establish Quality Assurance Systems. The Sister Lab program should support the development of the Tajura quality assurance program through the review and comment of the Tajura Quality Assurance Manual.

Discussion: The Tajura quality assurance program documentation is in its early stage of development. The development would be expedited through the submission of draft documents to the Sister Lab program for expert QA review and comment.

DOE/NNSA provides a National Laboratory instructor to assess and provide guidance in the development of quality assurance systems aimed at maintaining institutional competence. The following areas should be investigated:

- Records management techniques and methods.
- Retention and dissemination of knowledge to be gained through “lessons learned.”
- Employee cross training framework to assure the retention of “corporate knowledge” in the event of key staff departure.

Proposed Task: REWDC identify quality assurance personnel to undergo training by the DOE/NNSA experts in using quality assurance approaches to investigating incidents and issues.

Recommendation 8 – Develop Quality and Safety Manual and training. DOE/NNSA provide a quality assurance expert to review records and records management system to assure appropriate records are being kept.

Discussion: The current staffing levels of the Tajura Quality Assurance Unit are not adequate to address the facility's short-term document generation needs, nor the facility's long-term need to implement and maintain a robust defensible quality assurance program. This is a resource commitment that the Tajura management will have to evaluate in order to obtain and retain ISO 9001 certification.

Proposed Task: Tajura management should conduct a review of quality assurance staffing needs to address short-term timely documentation generation and long-term ability to implement and manage a robust quality assurance program.

Recommendation 9 – Improve the development and delivery of training. DOE/NNSA provide assistance to establish skills for improving the development and delivery of training with additional testing and validation capabilities.

Discussion: The Tajura facility will need to be able to provide initial and on-going quality assurance training to its facility personnel to support implementation of its quality assurance program. The most cost-effective and practical means of providing training is computer-based training. The training should address the most applicable quality assurance standard - for the Tajura site that would be the ISO 9001 standard.

Proposed Task: The Sister Lab program provide the Tajura facility commercially available ISO 9001 training computer media to ensure that initial and on-going quality assurance training is available.

Recommendation 10 – Establish Integrated Safety Management. Provide DOE instruction and guidance on the development of an Integrated Safety Management (ISM) system for the REWDC site. The following areas of instruction should be investigated:

- ISM training for REWDC managers aimed at improving the quality and safety culture.
- Guidance on and methods to begin systematic integration of quality assurance and safety into management and work practices at all levels.
- Guidance on evaluating whether missions are accomplished through effective integration of quality assurance and safety management.
- Guidance on assuring that all facets of work planning and execution are driven in accordance with ISM principles.

Discussion: The ability to assess the level of implementation in a defensible and accountable manner is crucial to the effective implementation of a quality assurance program. The Tajura Quality Assurance Office Head demonstrated the beginnings of establishing an internal auditing program, but it lacked the structure and formality that would be needed to demonstrate defensible oversight.

Proposed Task: The Sister Lab program should provide the Tajura facility an editable version of a formal internal auditing procedure for their adaptation and implementation. Additionally, the Tajura Quality Assurance Office Head should attend formal auditor training, preferably ISO 9001 Lead Auditor training.

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APPENDIX A

RADIOACTIVE WASTE MANAGEMENT AT LLNL

Outline of presentation given at the REWDC Facility by Robert Fischer, Group Leader, Radioactive and Hazardous Waste Division, LLNL

- Waste Characterization
- Generator Interface
- Sampling
- Waste Analysis
- Facility Decontamination and De-activation
- Transportation
- Waste Disposal
- Research
- Environmental Management System
- Quality Assurance
- Sister-Lab Program Experience

APPENDIX B

RADIOACTIVE WASTE TREATMENT AT LLNL

Outline of presentation given at the REWDC Facility by Scott Kidd, Waste Treatment Group, Radioactive and Hazardous Waste Management Division, LLNL

- History of waste treatment at LLNL
- Overview of current waste treatment and storage facilities
- Description of waste treatment process
  - Collection
  - Filtration
  - Evaporation
- Unique waste streams

APPENDIX C

QUALITY ASSURANCE

Outline of presentation given at the REWDC Facility by James Merrigan - Safety and Environmental Protection Directorate Assurance Manager, LLNL

- Presentation Overview
- Key Definitions
- The Basics of Quality Assurance
- Criteria of a QA Program
- QA Implementation Example
- QA Program Requirements
- The Basics of Quality Assurance
- Training & Qualification Requirements
- Quality Improvement Requirements
- Documents & Records Requirements
- Work Process Requirements
- Design Requirements
- Procurement Requirements
- Inspection & Acceptance Testing Requirements
- Management Assessment Requirements
- Independent Assessment Requirements
- QA as a Problem Solving Tool
- Problem Identification
- Application: Investigating a Defective Container
- Summary

APPENDIX D
REWDC WASTE STREAMS

Waste Stream	Amount	Contaminants	Point of Generation	Type of Waste	Process	Tentative Treatment method	Disposal Options
Hot cell Wash down (rinsate)	2 m^3/6 month	TeO_2, I, & Potassium Permanganate	Hot Cell	Liquid	Accidental Spills inside Hot cells	Decay Sample Release/ Evaporate	Onsite disposal as LLW of evaporator concentrate
Drying TeO_2 Crucibles	100g/2 weeks	TeO_2	Hot Cell	Solid	Dry Distillation Method		Dispose of as LLW
Sulfuric Acid	100 ml/ 2 Weeks	TeO_2 and I	Hot Cell	Liquid	Dry Distillation Method	Condition in cell	Dispose of as LLW
Rinsate (glass ware Washing)	200 ml/2 weeks	TeO_2 and I	Hot Cell	Liquid	Dry Distillation Method	Decay, sample, release	N/A
Spent Charcoal	50 g/ 2 weeks	I	Hot Cell	Solid	Dry Distillation Method	Condition in cell	Dispose of as LLW or Evaluate for decay and release
Contaminated Vacuum Water	5 m^3/ 2 weeks	I	Vacuum Pumps Compartments	Liquid	Tc-99M Production	Decay Sample Release or Evaporate	Onsite disposal as LLW of evaporator concentrate
Tc-99M Production	200 ml/ 2 weeks	MoO_3	Lab Shielded Unit	Liquid	Tc-99M Production	Condition in cell	Dispose of as LLW
Exchange Cation Resin Columns	10 gr/ week	Mo & Tc	Lab	Solid	Tc-99M Production	Solid waste	Dispose of as LLW

APPENDIX D, CONTINUED
REWDC WASTE STREAMS

Waste Stream	Amount	Contaminants	Point of Generation	Type of Waste	Process	Tentative Treatment method	Disposal Options
Aluminum Columns (Aluminum Oxide)	10 gr/ week	Mo & Tc	Lab	Solid	Tc-99M Production	Solid waste	Dispose of as LLW
Irradiation Container (aluminum) - Tc-99	Tc-99 container/ week	Tc-99	Hot Cell	Solid	Removing Sample from Irradiated Tc-99	Solid waste	Dispose of as LLW
Irradiation Container (aluminum) - T-131 and Br	I-131 container/ week	I-131	Hot Cell	Solid	Removing Sample from Irradiated Tc-99	Solid waste	Dispose of as LLW
Wastewater from Glassware washing from Labs	3000 l/month	Low pH	Lab Sinks	Liquid	Glassware Rinsate	Sample Release or Evaporate	Onsite disposal as LLW of evaporator concentrate
Oil/Water waste	5 Gal/3 months	Oil	Machine Shop	Liquid	Machine Cooling	Haz only waste	N/A
Reactor Pool Water Purification/Filtration	5 m^3/Hr	?	Reactor Pool	Liquid	Reactor Pool Filtration	Filter/ion exchange	Condition spent ion exchange media and dispose of as LLW
HEPA Filters	6 with housing	I, Am, Br, Cs	Ventilation System	Solid	HEPA Filters Replacements	Condition for disposal	Dispose as LLW
Waste Oil	5 gal/month	Oil	Machine Shop, Car Maintenance	Liquid	Oil Change	Haz only waste	N/A

APPENDIX D, CONTINUED
REWDC WASTE STREAMS

Waste Stream	Amount	Contaminants	Point of Generation	Type of Waste	Process	Tentative Treatment method	Disposal Options
Spent Solvents	5 Gal/3 months	Acetone, MEK, etc	Machine Shop	Liquid	Cleaning	Haz only waste	N/A
Fire Alarm Detectors	3 Drums	Am	All Facilities	Solid	Fire Alarm Detectors Replacement	Condition for disposal	Confirm final waste form meets LLW and then dispose
PPE	55 Gal/Month	Am, I, Br, Cs	Hot Cell and Analytical Labs	Solid	Experiments	Compact for disposal	Dispose of as LLW
Waste Water from Laundry	250 gal/week	Am, I, Br, Cs	Laundry Machine Room	Liquid	Laundry	Sample release or Evaporate	Onsite disposal as LLW of evaporator concentrate
Light Bulbs	2 Drum/Year	Hg	All Facilities	Solid	Light Bulbs Replacement	Sample release as haz only	N/A

APPENDIX E

Evaporator

For more details: www.evaporator.com

APPENDIX F

Compactor

55AR & 85AR
Built for continuous duty & demanding applications using 55 or 85 gallon drums.

The **55AR** and the **85AR** are designed for round-the-clock operation. The 3/8-inch thick rolled steel plate compaction chamber is virtually indestructible. And the tough positive-displacement piston pump and 10-HP motor guaranty a fast compaction cycle.

And like most of the other RAM FLAT Compactors, the **55AR** and **85AR** can be supplied with a bolt-on Crushing Plate that lets the operator crush empty drums with the same machine.

The **55AR** & **85AR** have been used for reducing the volume of radioactive waste, paint filters, transformer cases and for destruction of products like cathode ray tubes. With a remote control option, these machines have been installed in a radioactive "hot cell" area that permitted the operator to load and unload the compactor safely from another room.

* 85,000 lbs. hydraulic force for inside drum compaction/drum crushing.
* 55AR & 85AR have an extra large drum clearance for material overfill.
* **85AR for drums up to 85 gallons.**
* **55AR for drums up to 55 gallons.**
* 6" cylinder with 5" chrome rod.
* Lateral support rods minimize piston rod stress.
* 0.375 Steel Plate Crushing Chamber with 1.5" thick base plate.
* 1" Steel Compaction Head with reinforcing gussets.
* Positive Displacement Piston Pump for consistent cylinder travel speed.

Models Available
Model 55AR / 85AR
10-HP TEFC pump motor
115V Electrical Control Circuit automatic pushbutton cycle
115V Electric Door Interlock
Model 55AR-P / 85AR-P
10-HP Class 1, Division 1, Group D explosion-proof pump motor
Non-sparking pneumatic Control Circuit with Automatic Pushbutton Cycle
Pneumatic Door Interlock
Model 55AR-HY / 85AR-HY
10-HP Class 1, Division 1, Group D explosion-proof pump motor
Non-sparking hydraulic Control Circuit with Automatic Pushbutton Cycle
Hydraulic Door Interlock

Available Accessories
* Drum Handling: Move drums to and from the compactor.
* Alternate Compaction Head - (CH): Crush empty drums with the same machine.
* Bolt-On Crush Plate- (CP): For quick change out between compacting & crushing.
* NEMA 4 Water Tight Enclosures: A must for outside installations.
* RAM BOTTOM LOCK Control: Control material spring back.
* PAK-MORE Hold-down Disk: Improve volume reduction.
* Air Filtration and Ventilation: Control dust & vapors.
* Liquid Containment: Control spills or leftover residue.
* Special Custom Options

For more details: http://www.ramflat.com/dc5585ar.html

APPENDIX G

Cementation Process

The patented PowerMix* combines a planetary blade and a high-speed dispersion blade. Both agitators are in constant motion.

The planetary and the high-speed disperser blades rotate on their own axes and also rotate continuously around the vessel. The planetary blade feeds materials directly into the high shear zone of the orbiting high-speed disperser. This combination of unique mixing actions combine to eliminate the need for multiple mixers that this one machine can accomplish.

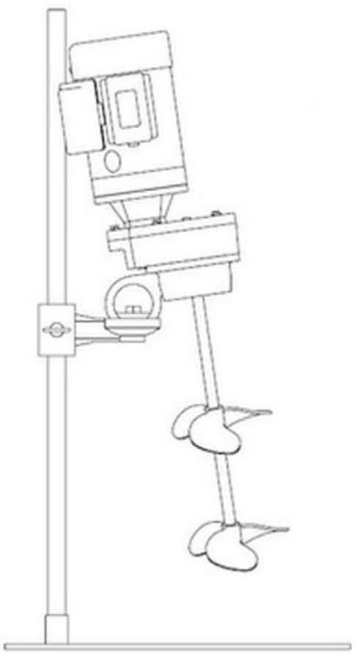
Both agitators are independently variable speed to permit users to fine-tune the speeds to the process at hand. The PowerMix is available in sizes from 1/2 through 750 gallons and can be supplied with many options such as vacuum/pressure, jacketed vessels, etc.

* Patent No. 4,697,929

For more details: http://www.mixers.com

APPENDIX H

Small Scale Immobilization System



Lab Mount / Hand Held

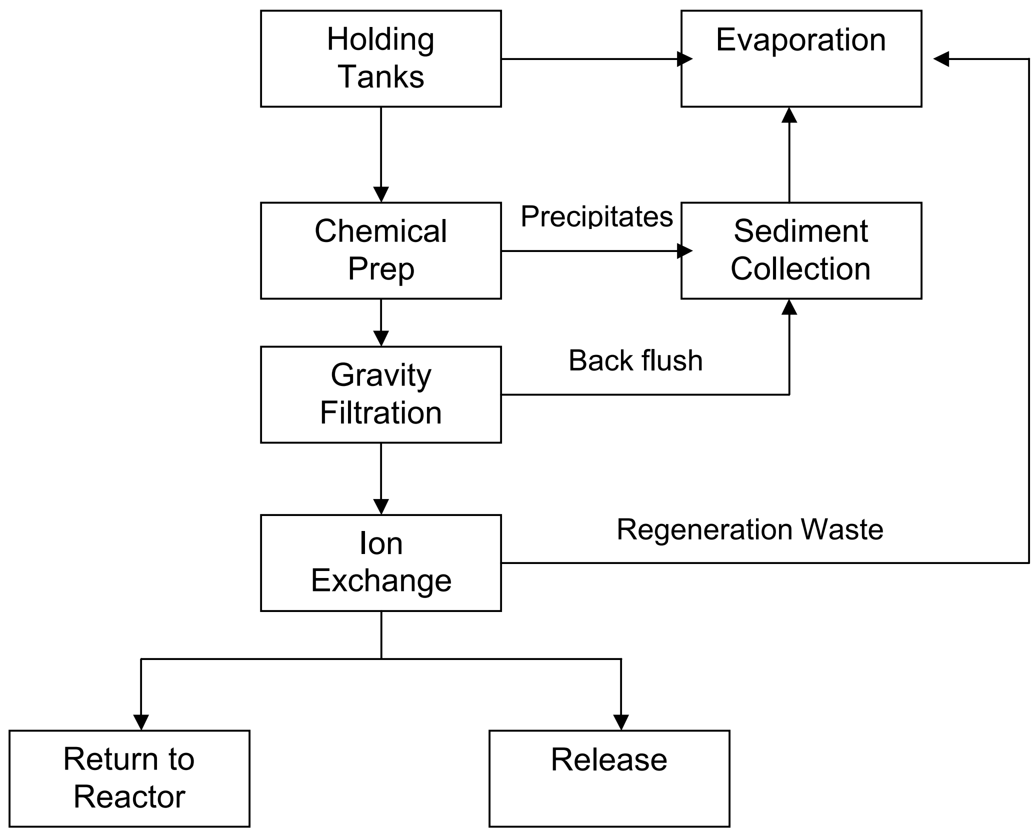
Series 200

These heavy-duty lab mixers feature a shaft support bearing to steady the mixing shaft and reduce wear on the motor. The Series 200 lab mixers can be adjusted vertically on the stand while also incorporating a universal ball & socket mount for precise positioning of the mixer shaft (lab stand included with purchase).

For more details: http://www.grovhac.com

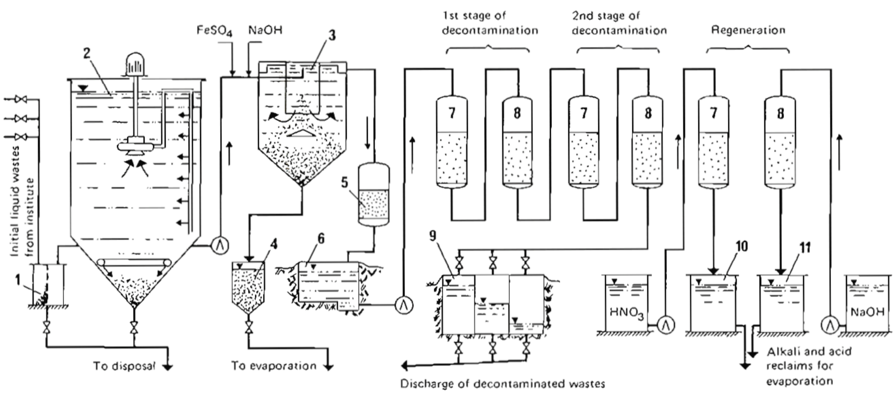
APPENDIX I

Liquid Waste Process Flow



APPENDIX J

Moscow Station Treatment System

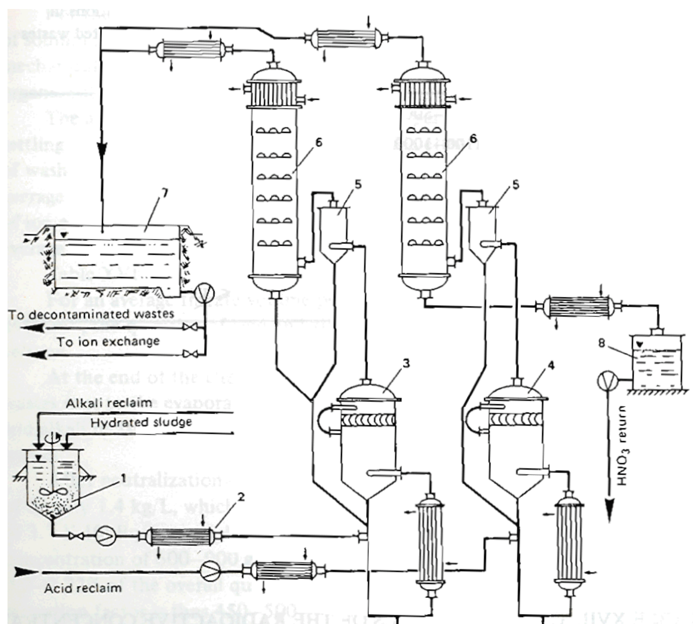


1. Coarse decontamination filter grid
2. Reservoir-homogenizer (500 m³)
3. Vertical settling tank
4. Hydrated sludge collector
5. Clarifying sand filter
6. Clarified liquid waste reservoir
7. Cation exchange filter
8. Anion exchange filter
9. Decontaminated waste control reservoir
10. Acid solution from cation-exchange regeneration
11. Alkali solution from anion-exchange regeneration

FIG.23. Equipment and flow chart for the chemical decontamination section (Moscow Station).

Reprinted from International Atomic Energy Agency Technical Reports Series No. 236, Treatment of Low- and Intermediate-level Liquid Radioactive Wastes

published in Austria, July, 1984



1. Preparation of solution for alkali evaporation
2. Heat exchanger
3. Evaporator for concentrating alkali solutions
4. Evaporator for concentrating acid solutions
5. Cyclone trap
6. Rectification column
7. Reservoir for collection of acid and alkali condensates
8. Distilled nitric acid collector
9. Reactor crystallizer
10. Special lorry for transport of waste to disposal

FIG.24. Concentration section (Moscow Station).

APPENDIX K

ACTION SHEET P-05-05
BETWEEN
THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA
AND
THE LIBYAND NATIONAL BUREAU OF RESEARCH AND DEVELOPMENT
FOR
TECHNICAL ASSISTANCE IN RADIOACTIVE WASTE MANAGEMENT

1. Introduction

The U.S. Department of Energy with its National Laboratories and the Libyan National Bureau of Research and Development (NBRD), through the Renewable Energies and Water Desalination Center (REWDC), have agreed to carry out consultation, cooperation, and the transfer of information to assist with low- and intermediate-level radioactive waste management. This undertaking is pursuant to *Arrangement Between the United States Department of Energy and the Libyan National Bureau of Research and Development for Information Exchange and Cooperation in the Peaceful Uses of Nuclear Energy.*

2. Scope of Work

The goal of the proposed work is to assist the REWDC in planning and development of a program for low- and intermediate-level radioactive waste management. The scope of this Action Sheet is to facilitate the transfer of knowledge, both in administrative and technical issues, needed for the establishment of an effective capability in this area.

The work identified under this Action Sheet shall be performed at DOE National Laboratories and REWDC facilities in accordance with the terms and conditions of the Arrangement. The proposed work will be complementary to efforts and activities in other active U.S.-Libyan Action Sheets. Technology transfer, training, and collaborations are contingent upon U.S. Government approval and in accordance with U.S. law.

3. Project Management

DOE and its National Laboratories shall work with the REWDC in planning tasks and resolving programmatic and technical questions.

DOE National Laboratories are responsible for technical consultation and training. The REWDC is responsible for providing relevant operational and other information required to achieve the project objectives. Project work plans will be prepared with projected milestones for each phase of the work. DOE National Laboratory counterparts shall prepare a brief, written, semi-annual progress report on tasks of this Action Sheet and provide it to the REWDC and DOE/NNSA. DOE National Laboratory technical experts and REWDC shall prepare and present written and oral reports as required for program meetings and program reviews.

4. Fiscal Management

Unless otherwise agreed, all costs associated with the work described in this action sheet shall be the responsibility of the party that incurs them. DOE National Laboratories shall be responsible for budget planning and financial management upon receiving designated funding and authorization from DOE/NNSA. The ability of the parties to carry out their obligation is subject to the appropriation of funds by the appropriate governmental authority and laws and regulations applicable to the parties as outlined in the Arrangement.

5. Tasks

Joint Assessment of Existing Capabilities and Materials

DOE National Laboratory staff will visit REWDC for a joint assessment of the existing capabilities, equipment, and radioactive waste. This assessment will include identification of existing and future radioactively contaminated materials and equipment, as well as new equipment and systems that need to be acquired. At the end of the joint assessment, DOE Laboratory staff will generate a report that contains specific findings and recommendations relevant to this subject.

Training in Radioactive Waste Management

DOE National Laboratory staff and REWDC will collaborate to provide focused training for intermediate- and low-level nuclear waste management. This assistance will include transfer of information, manuals, and training aids. DOE National Laboratory staff will assist with the development of this program emphasizing radiation safety, best practices, IAEA requirements and ALARA (as low as reasonably achievable). Specific training will be conducted in a) waste sampling and testing, and in characterization, b) waste treatment, storage, and disposal, and c) ALARA principles. This task will evaluate the applicability of training for existing equipment (e.g., Russian evaporation system).

Identify Potential New Collaborations for Applications for the Reactor Facility

Jointly develop new areas for collaboration and Action Sheets in applications that utilize the research reactor and associated laboratory facilities. New projects could include training for newly acquired waste handling and treatment equipment.

6. Schedule

The schedule shown below will be followed on a best-effort basis commencing on readiness of participants and availability of funding. U.S. fiscal year begins 1 October.

Activity	FY05				FY06				FY07			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4
Assessment of Existing Capabilities and Materials					X	X						
Waste Management Training							X	X	X	X		
Develop New Collaborations								X	X			

7. Duration and Termination

This Action Sheet shall enter into force upon the later date of signature and shall continue into force according to the schedule above or until mutually agreed by the both parties.

8. Key Personnel

REWDC

Dr. Salem Ghurbal, Director
Renewable Energy and Water Desalination Research Center

Dr. Mohamed Ali Busitta, Head of Department
Basic and Applied Research Department
Renewable Energy and Water Desalination Research Center

Dr. Sami M. Elwaer, Section Head
Radiochemical Section
Basic and Applied Research Department
Renewable Energy and Water Desalination Research Center

United States Department of Energy

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Mona Dreicer
Deputy Division Leader
Proliferation and Terrorism Prevention Division